

VI. CLAIMS

We claim:

1. A process for decomposing waste plastic comprising the steps of:
- supplying waste plastic;
 - mixing said waste plastic with a diluent to create a solution;
 - controlling the content of said solution to assure that it will contain a sufficient free radical content when heated; then
 - heating said solution to a reactant temperature to substantially depolymerize the waste plastic; and
 - collecting the by products of said depolymerization process.
2. A process for the recycling of waste plastic comprising:
mixing ^{the group consisting of} said waste plastic, selected from comminuted-waste-plastic comprising polyethylene, polypropylene, polystyrene, polyethylene terephthalate, polyvinyl chloride, other waste plastic, and combinations thereof, with oil, selected from waste motor oil, fluidized catalytic cracker slurry oil, distillation tower vacuum bottoms, and heavy heating or bunker oil, and combinations thereof, and free radical catalyst precursor; heating to between 325 and 375 °C for less than about one hour: and meeting process energy requirements by recycling back burnable products.
3. A process for decomposing waste plastic as described in claim 1 wherein said step of heating said solution to a reactant temperature to substantially depolymerize the waste plastic comprises the step of heating to less than about 400 °C.
4. A process for decomposing waste plastic as described in claim 1 wherein said step of heating said solution to a reactant temperature to substantially depolymerize the waste plastic comprises the step of heating to about 375 °C.
5. A process for decomposing waste plastic as described in claim 1

wherein said step of controlling the content of said solution to assure that it will contain a sufficient free radical content when heated comprises the step of adding an additional substance to said process.

5 6. A process for decomposing waste plastic as described in claim 1 wherein said step of controlling the content of said solution to assure that it will contain a sufficient free radical content when heated comprises the step of assuring an appropriate amount of free radical precursor is present in said process.

10 7. A process for decomposing waste plastic as described in claim 6 wherein said step of assuring an appropriate amount of free radical precursor is present in said process comprises the step of adding a particular waste plastic material to said process.

15 8. A process for decomposing waste plastic as described in claim 6 wherein said step of assuring an appropriate amount of free radical precursor is present in said process comprises the step of adding a substance chosen from a group consisting of polyvinyl chloride and polyurethane.

20 9. A process for decomposing waste plastic as described in claim 1 wherein said step of controlling the content of said solution to assure that it will contain a sufficient free radical content when heated comprises the step of sensing the relative amount of free radicals likely to be present in said solution after it is heated.

25 10. A process for decomposing waste plastic as described in claim 9 wherein said step of sensing the relative amount of free radicals likely to be present in said solution after it is heated comprises the step of ascertaining the reactant temperature of the solution.

30 11. A process for decomposing waste plastic as described in claim 1 and

further comprising the step of recycling a portion of said diluent. *to where?*

12. A process for decomposing waste plastic as described in claim 1 and further comprising the step of recycling from 0 to 95% of said diluent. *to where?*

13. A process for decomposing waste plastic as described in claim 11 wherein said step of recycling a proportion of said diluent comprises the step of recycling from 70% to 90% of said diluent. *to where?*

14. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with an oil.

15. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with a heavy oil.

16. A process for decomposing waste plastic as described in claim 1 wherein said step of mixing said waste plastic with a diluent to create a solution comprises the step of mixing said waste plastic with a low value oil. *?*

17. A system for decomposing waste plastic comprising:

- a. a first, second, and third supply means;
- b. a mix means responsive to at least two of said supply means;
- c. a reaction container connected to said mix means and responsive to said third supply means;
- d. a temperature control means connected to said reaction container;
- e. a collection means connected to said reaction container; and
- f. a control means wherein said third supply means is responsive to said control means.

18. A system for decomposing waste plastic as described in claim 17 wherein said first supply means supplies waste plastic and wherein said second supply means supplies a diluent.

5 19. A system for decomposing waste plastic as described in claim 18 wherein said second supply means supplies an oil.

10 20. A system for decomposing waste plastic as described in claim 19 wherein said second supply means supplies an oil selected from waste motor oil, fluidized catalytic cracker slurry oil, distillation tower vacuum bottoms, heavy heating or bunker oil, or combinations thereof.

15 21. A system for decomposing waste plastic as described in claim 17 wherein said temperature control means achieves temperatures of no more than 400 °C.

20 22. A system for decomposing waste plastic as described in claim 20 wherein said control means is responsive to the temperature within said reaction container.